MAR06-2005-040040

Abstract for an Invited Paper
for the MAR06 Meeting of
the American Physical Society

Bubble microstreaming: Force focusing on lipid membranes

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Ultrasound-driven oscillating microbubbles at container walls excite steady streaming flows of surprising speed that can be directed and controlled by patterning of the substrate. This new kind of microfluidics is simple to set up and does not need microchannels to guide flow transport. Hydrodynamic forces are locally focused around the oscillating bubbles and can be used to deform and rupture soft objects, such as the lipid membranes of vesicles and cells. We demonstrate these processes in experiment and quantify the stress exerted onto soft objects in the flow, investigating small and large deformations. We point out applications in bio-MEMS and biomedical studies of cellular response to hydrodynamic stimuli.